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LISTS OF SPECIES

List of Angiosperm species of the riparian vegetation of the Apodi-Mossoró river, Rio Grande do Norte, Brazil

Regina Célia de Oliveira [1*], Anádria Stéphanie da Silva [1], André Rodolfo de Oliveira Ribeiro [1], José Erivaldo de Araújo [2], Odaci Fernandes de Oliveira [2] and Ramiro Gustavo Valera Camacho [3]

1 University of Brasília, Institute of Biology, Department of Botany, PO Box 4457, 70919-970. Brasília, Distrito Federal, Brazil.
2 Federal Rural University of Semiarid, Department of Plant Sciences, PO Box 137, 59625-900. Mossoró, Rio Grande do Norte, Brazil.
3 Rio Grande do Norte State University, Department of Biological Sciences, PO Box 70, 59610-210. Mossoró, Rio Grande do Norte, Brazil.
* Corresponding author. Email: *reginacelia@unb.br*

ABSTRACT: This article describes the riparian vegetation of a river in the Rio Grande do Norte state for the first time. This is a seasonal river in the semiarid region of the Caatinga biome. The study is based on data from herbarium collections and new expeditions from July 2007 to October 2008. Two hundred and forty seven taxa were recorded and of these, 116 are herbs and three of which are epiphytes, 25 sub-shrubs, 77 shrubs or trees, 26 lianas, one parasite, and two palms. This list of species of riparian vegetation in the river Apodi-Mossoró was compared with only two available lists from rivers in the northeast with similar environmental characteristics and showed a low similarity. This study points to the need for preservation of the species and remnants of riparian vegetation of the river Apodi-Mossoró and to increase efforts in the study of this vegetation type.

INTRODUCTION

The Apodi – Mossoró river basin, with an area of 14,268 km^2 (corresponding to 26.8% of the estimated area of the Rio Grande do Norte State), occurs in the Caatinga biome where the climate is very hot and semi-arid (SEMARH 1998), BSw'h' according to Köppen classification, being surrounded by the Araripe mountains and Borborema plateau (Rocha *et al.* 2009). The source and mouth of the river Apodi Mossoró are in the Rio Grande do Norte and it has 618 dams (Henry-Silva 2010), with a total water volume of 469.714.600m3 (SEMARH 2012).

The course of the river was the main route of Portuguese penetration into the interior of Rio Grande do Norte in the eighteenth century and its margins were already used for the establishment of corrals and gardens (Monteiro 2002). Currently, the major activities that interfere directly in the river are irrigated fruit growing, family agriculture, salt production, mineral exploration and oil production, which environmental and economic impacts focus entirely on the river basin (Rocha *et al.* 2009). Logging of riparian vegetation is also intense and is documented below.

With early deforestation and salinization of large areas downstream, little is left of the original riparian flora of the temporary rivers in the semi-arid Northeast and is curious to note that the descriptions of these vegetation types are contradictory. For Ab'Sáber (1999a, b; 2001) these "matinhas beiradeiras" of the northeastern rivers may be called "forests of craiba" (*Tabebuia aurea* (Silva Manso) Benth. and Hook. F. ex Moore). Andrade-Lima (1981) on the other hand characterizes them a palm forest, where the dominant taxa are *Copernicia prunifera* (Mill.) H.E. Moore, *Licania rigida* Benth. and *Geoffroea spinosa* Jacq., and he does not mention craiba. The descriptions of Ab'Saber and Andrade Lima refer only to dominant taxa, and the riparian northeastern forests have been misinterpreted in that they contain a small number of species.

Complete lists of species of the riparian forests of Rio Grande do Norte were not found. The work of Tavares *et al.* (1975), although referring to the vegetation of the Piranhas-Açu basin, did not focus on the riparian vegetation. For other northeastern states knowledge of riparian vegetation is also rare. Noteworthy are the work of Nascimento *et al.* (2003), along the São Francisco river, and Lacerda *et al.* (2005), expanded by Lacerda and Barbosa (2006) for Taperoá river basin in Paraiba. In Pernambuco, there are studies on riparian vegetation of the river Pajeú (Souza and Rodal 2010), and an ethnobotanical study on the riparian vegetation of the river Navio, both in the Floresta municipality (Ferraz *et al.* 2006).

This study was conducted primarily to list the richness of Angiosperm taxa of the riparian vegetation of the Apodi-Mossoró river and discuss general aspects of this vegetation type, providing subsidies for its restoration and management.

MATERIALS AND METHODS

Figure 1 shows the river Apodi-Mossoró, which source is in the Serra dos Minhuns, Tigre de Cima district, in the municipality of Luís Gomes (06°22'08.8" S, 38°28'54.6" W) in the western region of Rio Grande do Norte, passing through the municipalities of Luís Gomes, Pau dos Ferros, Rafael Fernandes, Riacho de Santana, Apodi, Felipe Guerra, Governor Dix-Sept Rosado, Mossoró and empties between Areia Branca and Grossos (04°56' S, 37°09' W) into the Atlantic ocean.

The vegetation of the mountainous municipality of Luís Gomes consists mainly of semi-deciduous forest and, in this region, the climate is Aw' according to the Köppen classification, characterized by a tropical rainy climate with dry summer (SEMARH 1998). Even with the anthropic pressure of small farmers, this is the area along which the river is better preserved.

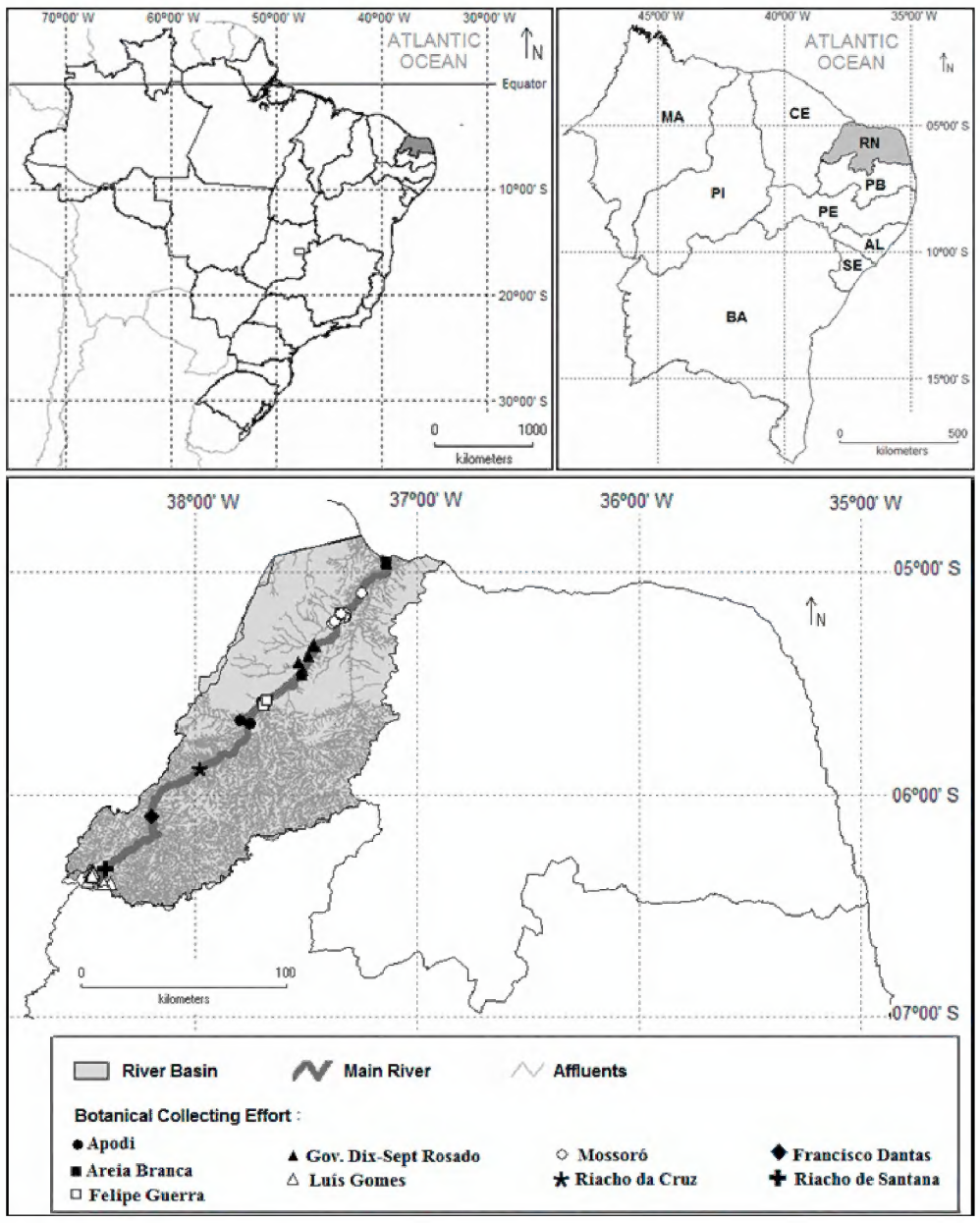

Figure 1. Localization map of Apodi-Mossoró river and municipality collection points.

The southern half of the basin consists of a Depression, a relief with predominantly flat plateau and Planaltos Residuais, which surfaces are delimited by erosional scarps with flat tops and sedimentary origin. The north-central portion of the basin is characterized by karst surface and in the far north, there is the coastal strip, according to data from SEMARH (1998) which presents more detail.

The floristic survey was based on the analysis of specimens deposited in the MOSS herbarium (acronym available in Thiers 2012) and new collections undertaken. Samples were collected monthly and some every two weeks, during the period from July 2007 to October 2008 (see Figure 1): 1) in the region of springs, in the municipality of Luís Gomes, 2) in preserved fragments in the municipality of Felipe Guerra, representing the middle portion of the river, and 3) in Mossoró, with estuarine characteristics. Additional collections were made in Governor Dix-Sept Rosado, Apodi, Riacho de Santana and Areia Branca.

The herbarium analysis showed species that were not found in the systematic field collection points. These species were then relocated based on the label information and with the aid of local informants.

The collections were made randomly within the area or directed by local informants. We sampled only fertile material, however a few tree species were only found sterile and their names were included in the list presented in Table 1. We included species occurring in small grassland patches and aquatic herbs, associated with riparian forests.

Identifications were made using literature, by comparison in the herbaria and sending material to specialists. The vouchers were incorporated into the MOSS herbarium and duplicates distributed to EAC, UFRN and others. Popular names were provided by local informants. Information provided by the riverside communities was the main source for determining the location of endangered species. The scientific names are in accordance to the list of species in the flora of Brazil (Forzza *et al.* 2012).

We compared the similarity of the tree and shrub flora of the river Apodi-Mossoró with lists published in Lacerda *et al.* (2005) and Souza and Rodal (2010), due to their geographic proximity and similarities in environmental factors. Table 1 presents the environmental characteristics of the regions occupied by the rivers whose floristic lists were used in this comparison. The unidentified taxa were considered exclusive or distinct. Sub-shrubs from Apodi Mossoró river vegetation were included in the comparison if those species were considered shrubs or trees in the other two published lists. The similarity between the flora of these areas was based on Sørensen index (Mueller-Dombois and Ellenberg 1974).

Results and Discussion

A total of 247 taxa were recorded in the Apodi-Mossoró riparian vegetation (Table 2), which represents the largest number of species records occurring along rivers in the Northeast. Of the species found, 116 are terrestrial or aquatic herbs and three epiphytes, 25 sub-shrubs, 77 shrubs or trees, 26 lianas, one parasite and two palm trees.

Non arboreal taxa: 119 species were found from this stratum (Table 1), represented in 28 families and 74 genera. Some taxa are illustrated in Figure 2. The Poaceae and Cyperaceae account for 41% of the herbaceous flora found in the riparian vegetation of this river. This large number of herbs is also due to sampling species from temporary ponds and associated pioneer taxa.

The families with the largest number of species were Poaceae (33 species), Cyperaceae (25 species), Asteraceae (14 species), Fabaceae (nine species) and Verbenaceae (five species).

The most diverse genera were *Cyperus* L. with 14 species, followed by *Eragrostis* Wolf, *Paspalum* L. and *Ludwigia* L. with four species each. *Tillandsia* Wilbr., *Eleocharis* R. Br, *Panicum* L., *Spermacoce* L. and *Lippia* L. had three species each and all other genera were represented by one or two species.

The species *Tarenaya spinosa* (Jacq.) Raf., *Cyperus compressus* L., *Croton heliotropiifolius* Kunth., *Chloris barbata* Sw., *Apalanthe granatensis* (Bonpl.) Planch., *Echinochloa colona* (L.) Link, *Heteranthera seubertiana*

Table 1. Characteristics of the river basins used in the similarity studies.

RIVER	LATITUDE	LONGITUDE	CLIMATE	GEOLOGY	HIDROLOGY
Apodi-Mossoró	06°22'0.8.8" and 04°56'	38°28'54.6" and 37°09'	BSwh'	Cristalino	Seasonal
Pajeú	07°16'20" and 08°56'01"	36°59'00" and 38°57'45"	BSwh'	Cristalino	Seasonal
Taperoá	06°51'31" and 07°34'21"	36°0'55" and 37°13'9"	BSwh'	Cristalino	Seasonal

Solms and *Eleocharis geniculata* (L.) Roem. and Schult. were recorded in all the collecting areas.

Araújo *et al.* (2005) compared the herbaceous diversity in flat, rocky and riparian microhabitats in the Caatinga biome. The richness, diversity and uniqueness of the herbaceous species in riparian habitat were higher than the others. The similarity between the occurrence of non-arboreal taxa from this study compared to the list of Araújo *et al.* (2005) is extremely low. The species that occurred in both lists are *Bomarea edulis* (Tussac.) Herb. (under *B. salsilloides* (Mart.) Benth. and Hook), *Dalechampia* cf. *scandens* L., *Heliotropium angiospermum* Murray, *Herissantia crispa* (L.) Briziky, *Panicum trichoides* Sw., *Panicum venezuelae* Hack, *Ruellia asperula* (Mart. and Nees) Lindau and *Tragia volubilis* L. *Dactyloctenium aegyptium* (L.) P. Beauv. and *Enteropogon mollis* (Nees) Clayton appear in the list of Araújo *et al.* (2005), but are not related to the riparian habitat. The low similarity of the herbaceous layer between the Apodi-Mossoró and Olaria stream may be related to the heterogeneity of the riparian vegetation of the northeastern rivers (discussed below in greater detail), but also due to differences between the phytogeographic subzones occupied by rivers.

The three phytogeographic subzones of the Northeast are called "Zona da Mata", "Agreste" and "Sertão". According to Barbosa *et al.* (2006), the Zona da Mata extends from the coast in a strip of approximately 100km wide and has humid tropical climate, fertile soil and occupied by atlantic rainforest. The Agreste is a transition area between the more humid Zona da Mata and the semi arid Sertão. Araújo *et al.* (2005) worked in an area of the Olaria stream located in the Agreste, called dry tropical forest by the authors. Works that deal with the distribution pattern of taxa in Pernambuco show that species richness varies between the subzones, with exclusive taxa occurring in each subzone. The Agreste has higher richness of taxa and exclusive species, when compared with the Sertão. Among others, the work of Barros *et al.* (1988) and Abreu *et al.* (2008) illustrate this distribution pattern by analysis of distant taxonomic groups, such as Pteridophytes and *Oxalis* L. (Oxalidaceae) respectively, with the higher number of taxa in the Agreste than in the Sertão and emphasize the occurrence of exclusive species, characteristic of each subzone. Maciel *et al.* (2010) showed that Agreste is populated with all the species of *Paspalum* L. (Poaceae) occurring in Pernambuco and that this subzone is the richest in exclusive species when compared with the Sertão, which, in turn, also has exclusive species. The Apodi-Mossoró river is restricted to the Sertão and Olaria stream to the Agreste.

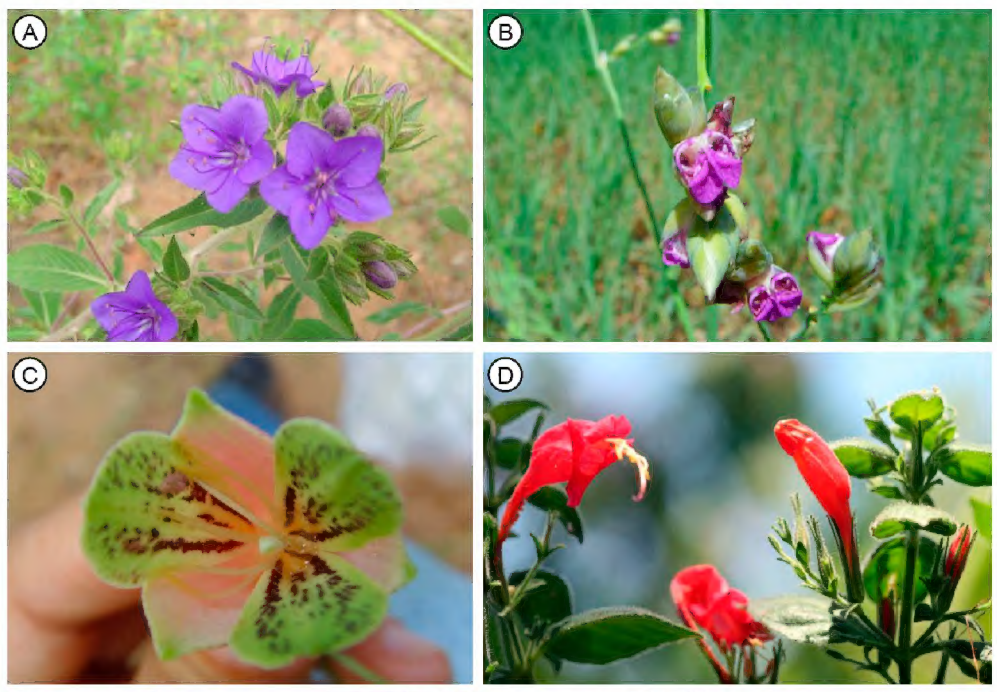

Figure 2. Some herbaceous species of Apodi-Mossoró River, Rio Grande do Norte, Brazil. HYDROLEACEAE: A. *Hydrolea spinosa* L.; MARANTACEAE: B. *Thalia geniculata* L.; ALSTROEMERIACEAE: C. *Bomarea edulis* (Tussac) Herb.; ACANTHACEAE: C. *Ruellia asperula* (Mart. and Nees) Lindau; CUCURBITACEAE: E. *Luffa operculata* (L.) Cogn.; F. *Rytidostylis amazonica* (Mart. ex Cogn.) Kuntze; POACEAE: F. *Echinochloa polystachya* (Kunth) Hitchc.; CYPERACEAE: G. *Pycreus polystachyos* (Rottb.) P. Beauv.

The time of year can also be the cause of low similarity, since Araújo *et al.* (2005) sampled only those species that occurred in the rainy season, with no data collected during the dry season. *Eragrostis hypnoides* (Lam.) Britton, for example, was only found in the dry season, occurring in the shrinking lake margins, which was also observed by Ferreira *et al.* (2009). Reis *et al.* (2006) and Lima *et al.* (2007) showed that due to variations in total rainfall between years, characteristic of northeastern climate, the herbaceous community structure can be changed and many populations can show drastic reductions in size, even disappearing completely from the area. Lima *et al.* (2007) evaluating the phenological differences between microhabitats in an area of caatinga, concluded that spatial variations in the microhabitats conditions associated with interannual variations in total rainfall may change the flowering period and recruitment of herbaceous plants. They also showed that a short time series may not be sufficient to describe the plasticity that exists within populations and infer the geographical distribution of some herbaceous species of the caatinga.

We sampled 30 species of lianas belonging to 25 genera, 14 families with one undetermined species. The families Fabaceae (seven species), Cucurbitaceae (five species) and Sapindaceae (four species) showed the highest species richness, accounting for 50% of the liana species found. Moreover, ten families (37%) were represented by a single liana species. The genera of higher species richness were *Luffa* Mill., *Cardiospermum* L. and *Paullinia* L., with two species each, and the remaining 20 genera (74%) had only one. Remarkably, 18 (66%) of the 27 species found occurred only in the Luís Gomes region, where the river sources were found. As previously mentioned, the source of the Apodi-Mossoró river is located in the Serra dos Minhuns, which has semi-deciduous vegetation. The occurrence of a significant number of lianas in a semi-deciduous vegetation was reported for the Rio Grande do Norte State (Oliveira *et al.* 2012), but there are several reports for the São Paulo State (Udulutsch *et al.* 2004;

Ranga and Rao 2005; Tibiriçá *et al.* 2006). Udulutsch *et al.* (2004) highlighted this high liana species richness as attributes of these seasonally semi-deciduous forest fragments. No published data on the occurrence of lianas in riparian forests of the Northeast temporary rivers was found.

Tree-shrub taxa: The family with the highest number of taxa was Fabaceae, with 19 genera and 30 species, followed by Euphorbiaceae, with four genera and five species. Figure 3 shows the illustration of tree-shrub taxa. Fabaceae and Euphorbiaceae also were cited as the richest families in species numbers in other surveys of the tree-shrub layer in areas of caatinga (Lemos *et al.* 2004; Amorim *et al.* 2005; Gomes *et al.* 2006; Santana and Souto 2006) and the seasonally semi-deciduous forests (Rodal *et al.* 2005).

Table 3 compares the number of tree taxa from the rivers Taperoá in Paraiba (Lacerda *et al.* 2005) and Pajeú in Pernambuco (Souza and Rodal 2010) with the results from this work. The total list of tree species considered in the three surveys shows that of the 103 species compiled, only nine were cited for riparian vegetation in all the rivers: *Aspidosperma pyrifolium* Mart., *Cnidoscolus quercifolius* Pohl, *Erythrina velutina* Willd. (Figure 3A), *Jatropha mollissima* (Pohl.) Baill., *Libidibia ferrea* (Mart. ex Tul.) L.P.Queiroz, *Lonchocarpus sericeus* (Poir.) Kunth ex DC., *Vitex gardneriana* Schauer, *Sideroxylon obtusifolium* (Humb. ex Roem. and Schult.) T.D. Penn and *Ziziphus joazeiro* Mart..

Figure 3. Some tree and shrub species of Apodi-Mossoró River, Rio Grande do Norte, Brazil. FABACEAE: A. *Erythrina velutina* Willd. SAPINDACEAE: B. *Sapindus saponaria* L. Fruits; APOCYNACEAE: C. *Cryptostegia grandiflora* R. Br., Invasive species; CAPPARACEAE: D. *Crataeva tapia* L.; POLYGONACEAE: E. *Triplaris gardneriana* Wedd. Fruits; CHRYSOBALANACEAE: F. *Licania rigida* Benth. Roots; FABACEAE: G. *Albizia inundata* (Mart.) Barneby and J.W.Grimes; ARECACEAE: H. *Syagrus cearensis* Noblick.

This same table shows that the number of unique tree taxa, or those quoted in only one of the three surveys is high. There are 18 species cited for Taperoá which did not occur in the other two areas, six were unique to the river Pajeú and 40 to the Apodi Mossoró river. The Sørensen index shows a low similarity between the tree–shrub flora of the river areas and Taperoá river shares more species in common with the Apodi Mossoró river (Table 3).

The large number of exclusive species in the riparian vegetation of the Apodi-Mossoró is probably due to sampling along the entire length of the river, which did not occur in the other two surveys. Thus, species occurring in the mangrove penetrated into the riparian vegetation, as is the case *Laguncularia racemosa* (L.) C.F. Gaertn., *Avicennia* spp. and *Lycium martii* Sendtn. collected in Mossoró, site with a strong estuarine influence. The same occurs in the region of springs in Luiz Gomes, which was surrounded by semi deciduous forest species, as is the case *Myrciaria tenella* (DC.) O.Berg (Pereira *et al.* 2002) and *Thiloa glaucocarpa* (Mart.) Eichler, *Copaifera* sp. among others. Figure 4 illustrates the various environments found in this work.

The description given by Ab'Sáber (2001) of a riparian vegetation of seasonal rivers in the Northeast, being dominated by "craiba" (*Tabebuia aurea*), could not be applied in any of the remaining sections of the river Apodi-Mossoró at least not today. No records of "craiba" were found along the Apodi-Mossoró river.

The rarity of "craiba" may be due to human influence. There are indications of a more frequent occurrence of this species, such as the name of a municipality in the watershed Apodi-Mossoró as Caraúbas, which is an obvious reference to "craiba" which is also called "caraúba" (Braga 1976). Another interesting fact that can aid the discussion, is that "craiba" showed higher use value in the study by Ferraz *et al.* (2006) in a creek in Pernambuco. However, according to these authors, the current use by the local population is not consistently associated with positive or negative impacts on the conservation of the species.

In Andrade-Lima (1982) characterization there is no reference to "craibeira" and the riparian vegetation of the Rio Grande do Norte, Ceará and Piauí seasonal rivers is a "forest of palms" with predominantly *Copernicia prunifera*, *Licania rigida* (Figure 3F) and *Geoffroea spinosa.* Interestingly, none of the dominant species considered by Ab'Saber (2001) or Andrade Lima (1982) were found in the list of species shared between the three areas.

The lack of "craiba" in the riparian vegetation of Apodi Mossoró today could be explained by human action, but the lack of "carnauba" in the Taperoá river (Lacerda *et al.* 2005; Lacerda and Barbosa 2006) is more complicated and seems to demonstrate that the riparian vegetation of the Northeast rivers is extremely heterogeneous and that the descriptions of Andrade-Lima and Ab'Sáber are not conflicting, but refer to different distinct contexts. The description given by Andrade-Lima (1981) demonstrates better the vegetation more frequently found in the small remnants along the Apodi-Mossoró river: great proliferation of "carnaúba" and "oiticicas" of considerable

size and the frequent presence of "marizeiro" or "umarizeiro".

Ab'Sáber (1999b) refers to "ariscos" which are grassy fields with groups of "carnaúbas". Formations that approach this description can be found in the Mossoró municipality, except for the presence of "craibeira", as mentioned in the previous paragraph. In these formations, *Cyperus articulatus* L. (Cyperaceae), locally known as "junco", covers the areas flooded and *Paspalum vaginatum* Sw. (Poaceae), surround the "junco ponds" in the drier portions of these wetlands. At the edges of these areas, the "joazeiro" (*Zizyphus joazeiro*) is very frequent.

In addition to differences in the composition of riparian vegetation between the rivers of the Northeast, there is a floristic heterogeneity of riparian forests conditioned by ecotonal nature of the border, which is occupied by more than one type of vegetation or distinct physiognomic formations, as emphasized by Rodrigues and Nave (2001). The fragments of the riparian vegetation studied along the Apodi-Mossoró river were shown to be heterogeneous in physiognomic and floristic terms.

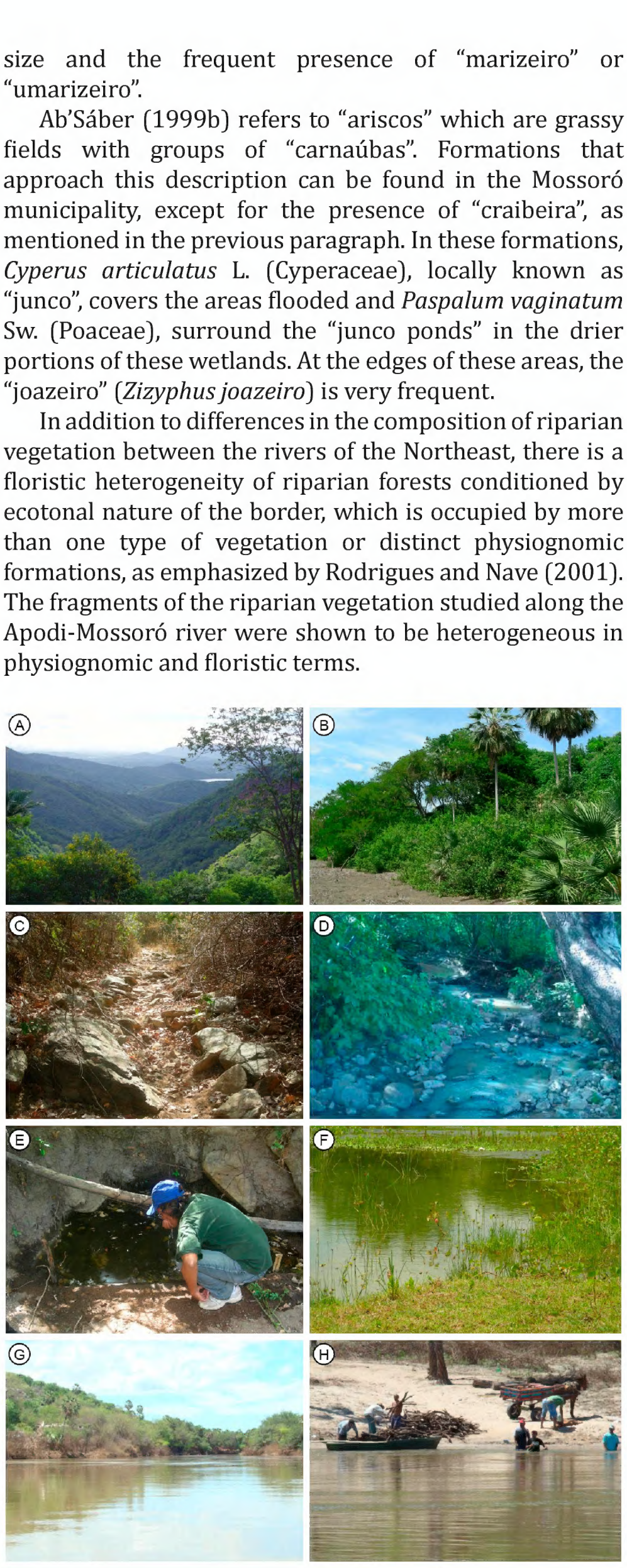

Figure 4. A. Riparian vegetation of a secondary river to Mossoró river, called Riacho do Rela, in Luiz Gomes, Rio Grande do Norte, Brazil; B. Seasonal lake, surrounded by riparian vegetation, with an abundance of *Albizia inundata* (Mart.) Barneby and J.W. Gremes and *Copernicia prunifera* (Mill.) H.E. Moore; C and D. Riparian vegetation of the main Mossoró spring source, Luiz Gomes municipality, C. dry season; D. rainy season; E. Perennial spring source in Luiz Gomes; F. Temporary lake in the rainy season, surrounded by *Paspalum vaginatum* Sw.; G and H. Apodi-Mossoró river in the municipality of Felipe Guerra, showing the intense logging.

According to Fernandes (2005), the influence of mountain forests in the composition of the riparian vegetation of the rivers of northeast is broad, since species have originated from the adjacent mountains. Similar proposition was made and substantiated by Oliveira Filho and Ratter (2001) to explain the extraordinary richness of the riparian vegetation of the Cerrado, and they suggest that elements of riparian vegetation were "imported" from neighboring forest formations.

In the municipality of Felipe Guerra, there are limestone outcrops along the river margins, covered by an open caatinga, where the herbaceous layer is conspicuous, with frequent occurrence of "pereiro" (*Aspidosperma pyrifolium*), "macambira" (*Bromelia laciniosa* Mart. ex Schult. f.) and "cactus" (*Cereus jamacaru* DC.). *Pithecoseris pacourinoides* Mart. ex. DC is a conspicuous element, found exclusively in these formations.

Besides eliminating the riparian vegetation as a whole, selective pressure on certain species is also likely to occur. Species considered typical and frequent (Andrade-Lima 1981), as *Geoffrea spinosa*, the popular "umarizeiro", have reduced populations today, even though the cooked fruit is well appreciated by riverine communities. *Sapindus saponaria* L. is also represented by a few individuals, located in Apodi.

Only two individuals of *Vitex gardneriana* Schauer, popularly called "jarimataia" and *Trichilia hirta* L., "barandão", were relocated and could be prioritized in recuperation programs to maintain these taxa in riparian vegetation of the Apodi-Mossoró river or at least in Apodi. The distribution of these species seems never to have been continuous along the length of the river, since the previous collection records are concentrated only in Apodi and communities of the source regions apparently did not know these species. According to reports from the riverside community of Apodi, stems from "jarimataia" and "barandão" are extracted to manufacture tool handles and fence posts.

Besides the removal of the riparian vegetation of the Apodi-Mossoró river, biological invasion by exotic species is common. The "algarroba" (*Prosopis juliflora* (Sw.) DC.) mixed with the native pioneer "jurema preta" (*Mimosa tenuiflora* (Willd.) Poir.), forms large tracts of vegetation along the river, especially in Mossoró. Another concern is the invasion by "unha-de-cão" (*Cryptostegia grandiflora* R.Br., Figure 3C), a species endemic to Madagascar and naturalized in tropical regions of the world (Vieira *et al.* 2004), which forms dense, impenetrable forests in floodplains. To a lesser extent, we observed the invasion of riparian vegetation by *Parkinsonia aculeata* L., whose impact in areas of the Northeast has been documented (Fabricante 2009).

The results of this study point to a small similarity between areas of riparian vegetation, as reported for other regions (Rodrigues and Nave 2001), but the small number of available studies do not provide a comprehensive view of the distribution of species in the seasonal rivers of semi-arid region of Brazil.

Table 2. Species list of the riparian vegetation of Apodi-Mossoró river, RN, organized in alphabetical order by family, with common names, habit, and voucher. RCO = Regina Célia de Oliveira; ASS = Anádria Stéphanie da Silva, Ribeiro = André Rodolfo de Oliveira Ribeiro and Cunha = E.M. (colector name unavailable) Cunha.

SPECIES	COMMON NAME	HABIT	VOUCHER
Acanthaceae			
Justicia aequilabris (Nees) Lindau	-	Shrub	RCO 2213
Justicia sp.	-	Shrub	RCO 2140
Ruellia asperula (Mart. and Nees) Lindau	-	Sub-shrub	ASS 2
Ruellia paniculata L.	-	Sub-shrub	RCO 2239
Alismataceae			
Echinodorus subalatus (Mart.) Griseb.	-	Herb	RCO 2169
Hydrocleys martii Seub.	-	Herb	RCO2303[a]
Alstroemeriaceae			
Bomarea edulis (Tussac) Herb.	-	Liana	RCO 2212
Amaranthaceae			
Alternanthera brasiliana (L.) Kuntze	-	Herb	RCO 2167
Alternanthera tenella Colla	-	Herb	RCO 2111
sp.1	-	Herb	RCO 1957
Anacardiaceae			
Myracrodruon urundeuva Allemão	aroreira do sertão	Tree	No voucher
Spondias mombin L.	-	Tree	No voucher
Apocynaceae			
Aspidosperma pyrifolium Mart.	Pereiro	Tree	RCO 2132
Cryptostegia grandiflora R. Br.	unha-de-cão	Liana	Cunha 12
Odontadenia puncticulosa (Rich.) Pulle		Liana	No voucher
Oxypetalum sp.	-	Liana	RCO 1939
Arecaceae			
Copernicia prunifera (Mill.) H.E. Moore	Carnaúba	Palm	No voucher
Syagrus cearensis Noblick	côco-catolé	Palm	RCO 2247
Asteraceae			
Acanthospermum hispidum DC.	-	Sub-shrub	RCO 2192
Acmella brachyglossa Cass. (citada só para Bahia na lista do Brasil)	-	Herb	RCO 2168
Ageratum conyzoides L.	-	Sub-shrub	RCO 2172
Bidens riparia Kunth	-	Herb	RCO 2130
Brickellia diffusa (Vahl) A.Gray	cabelo-de-cão	Herb	RCO 2309
Centratherum punctatum Cass.	-	Sub-shrub	RCO 2241
Melanthera nivea (L.) Small	-	Sub-shrub	RCO 1941
Mikania cordifolia (L.f.) Willd.	cesto-de-velho	Liana	RCO 1949
Pectis brevipedunculata Sch.Bip.	Alecrim	Herb	RCO 2184
Pithecoseris pacourinoides Mart. ex. DC.	-	Herb	RCO 1924
Porophyllum ruderale (Jacq.) Cass.	cravo-de-urubu	Herb	RCO 2183
Spilanthes sp.	-	Herb	RCO 1953
Wedelia sp.	-	Herb	RCO 2123
sp.1	-	Sub-shrub	RCO 1938
sp.2	-	Sub-shrub	RCO 2316
Bixaceae			
Cochlospermum vitifolium (Willd.) Spreng.	Pacote	Tree	RCO 2307
Boraginaceae			
Euploca procumbens (Mill.) Diane and Hilger	-	Herb	ASS 51
Euploca ternata (Vahl) J.I.M.Melo and J.Semir	-	Herb	RCO 2122
Heliotropium angiospermum Murray	-	Sub-shrub	RCO 2127
Heliotropium sp.	-	Herb	RCO 1821
Bromeliaceae			
Tillandsia recurvata (L.) L.	-	Epiphyte	RCO 2200
Tillandsia streptocarpa Baker	-	Epiphyte	RCO 2201
Tillandsia tricholepis Baker	-	Epiphyte	RCO 2202
Burseraceae			
Commiphora leptophloeos (Mart.) J.B.Gillett	-	Tree	No voucher
Cactaceae			
Cereus jamacaru DC.	-	Tree	No voucher
Capparaceae			
Crataeva tapia L.	Trapiá	Tree	ASS 43

Table 2. ***Continued.***

SPECIES	COMMON NAME	HABIT	VOUCHER
Cynophalla flexuosa (L.) J.Presl.	feijão-bravo	Tree	ASS 48
Cleomaceae			
Tarenaya spinosa (Jacq.) Raf.	Mussambê	Herb	ASS 31
Combretaceae			
Combretum leprosum Mart.	Mofumbo	Tree / Shrub	RCO 2137
Combretum lanceolatum Pohl ex Eichler	mofumbo-do-rio	Shrub	RCO 2329
Laguncularia racemosa (L.) C.F.Gaertn.	Mangue	Tree	Ribeiro 86
Thiloa glaucocarpa (Mart.) Eichler	-	Shrub	No voucher
Commelinaceae			
Tradescantia zanonia (L.) Sw.	-	Herb	RCO 2211
Convolvulaceae			
sp.1	-	Liana	RCO 2189
Chrysobalanaceae			
Licania rigida Benth.	Oiticica	Tree	RCO 2242
Curcubitaceae			
Luffa cylindrica M.Roem.	Bucheira	Liana	ASS 23
Luffa operculata (L.) Cogn.	-	Liana	ASS 45
Momordica charantia L.	melão-são-caetano	Liana	ASS 27
Rytidostylis amazonica (Mart. ex Cogn.) Kuntze	-	Liana	RCO 2190
sp.1	Jitirana	Liana	RCO 2191
Cyperaceae			
Cyperus aggregatus (Willd.) Endl.	-	Herb	RCO 2223
Cyperus articulatus L.	-	Herb	ASS 3
Cyperus compressus L.	-	Herb	RCO 2110
Cyperus cuspidatus Kunth	-	Herb	Ribeiro, 199
Cyperus distans L.f.	-	Herb	RCO 2222
Cyperus enterianus Boeck.	-	Herb	RCO 2224
Cyperus esculentus L.		Herb	Ribeiro 170
Cyperus iria L.	-	Herb	Ribeiro 172
Cyperus laxus Lam.	-	Herb	Ribeiro 4
Cyperus ligularis L.	capim-navalha	Herb	Ribeiro 19
Cyperus odoratus L.	-	Herb	RCO 2235
Cyperus rotundus L.	-	Herb	Ribeiro 95
Cyperus squarrosus L.		Herb	Ribeiro 181
Cyperus surinamensis Rottb.	-	Herb	RCO 2234
Eleocharis geniculata (L.) Roem. and Schult.	-	Herb	Ribeiro 6
Eleocharis minima Kunth	-	Herb	RCO 2253
Eleocharis mutata (L.) Roem. and Schult.	-	Herb	Ribeiro 5
Fimbristylis cymosa R. Br.	-	Herb	Ribeiro 7
Fimbristylis dichotoma (L.)Vahl	-	Herb	Ribeiro154
Lipocarpha micrantha (Vahl) G.C.Tucker	-	Herb	Ribeiro 184
Pycreus fugax (Liebm.) C. D. Adams	-	Herb	Ribeiro 167
Pycreus macrostachyos (Lam.) J.Raynal	-	Herb	Ribeiro 171
Pycreus polystachyos (Rottb.) P.Beauv.	-	Herb	Ribeiro 112
Rhynchospora contracta (Nees) J.Raynal	barba-de-bode	Herb	Ribeiro 2
Scleria reticularis Michx.	-	Herb	Ribeiro 180
Euphorbiaceae			
Cnidoscolus quercifolius Pohl	Faveleira	Tree	RCO 2152
Croton heliotropiifolius Kunth.	Velame	Sub-shrub	ASS 36
Croton sonderianus Müll. Arg.	Marmeleiro	Tree	RCO 1968
Croton sp.	-	Herb	ASS 50
Dalechampia cf. *scandens* L.	-	Liana	RCO 2171
Euphorbia sp.	-	Herb	RCO 2151
Jatropha gossypiifolia L.	pinhão-roxo	Sub-shrub	ASS 24
Jatropha mollissima (Pohl.) Baill.	Pinhão	Tree	ASS 35
Manihot carthaginensis subsp. *glaziovii* (Müll.Arg.) Allem	-	Tree	No voucher
Tragia volubilis L.	-	Liana	RCO 1933
sp.1	-	Shrub	RCO 2217
Eriocaulaceae			
sp.1	-	Herb	RCO 2251

Table 2. ***Continued.***

SPECIES	COMMON NAME	HABIT	VOUCHER
Erythroxylaceae			
Erythroxylum sp.		Tree	ASS 46
Fabaceae			
Albizia inundata (Mart.) Barneby and J.W.Gremes	-	Tree	ASS 55
Amburana cearensis (Allemão) A.C.Sm.	-	Tree	No voucher
Anadenanthera colubrina (Vell.) Brenan	Angico	Tree	RCO 2229
Anadenanthera colubrina var. *cebil* (Griseb.) Altschul	angico-branco	Tree	RCO 2305
Anadenathera sp.	angico-preto	Tree	RCO 2336
Arachis dardani Krapov. and W.C.Greg.	mundubim-de-carcará	Herb	RCO 2188
Bauhinia cheilantha (Bong.) Steud.	capa-bode	Shrub	RCO 2193
Bauhinia pulchella Benth.	mororó-da-serra	Tree	AROR 11
Bauhinia sp.	Mororó	Shrub	RCO 2182
Centrosema brasilianum (L.) Benth.	xibiu-de-negra	Liana	AROR 194
Chaetocalyx scandens (L.) Urb.	-	Liana	RCO 2226
Chamaecrista duckeana (P. Bezerra and Afr. Fernandes) H.S. Irwin and Barneby	-	Sub-shrub	RCO 2165
Chloroleucon dumosum (Benth.) G. P. Lewis	Arapiraca	Tree	RCO 1963
Copaifera sp.	pau-d`óleo	Tree	ASS 16
Cratylia argentea (Desv.) Kuntze	-	Liana	RCO 1945
Crotalaria retusa L.	guizo-de-cascavel	Herb	ASS 26
Dioclea grandiflora Mart. ex Benth.	Mucunã	Liana	RCO 1944
Erythrina velutina Willd.	Mulungu	Tree	RCO 1967
Geoffroea spinosa Jacq.	Marizeiro	Tree	ASS 34
Inga edulis Mart.	-	Tree	RCO 232
Libidibia ferrea (=*Caesalpinia ferrea* Mart. ex Tul. var. *ferrea*)	Jucá	Tree	RCO 1940
Lonchocarpus sericeus (Poir.) Kunth ex DC.	Ingazeira	Tree	ASS 53
Machaerium vestitum Vogel	Violeta	Tree	ASS 19
Macroptilium lathyroides (L.) Urb.	-	Herb	RCO 2219
Mimosa invisa Mart. ex Colla	-	Liana	RCO 2227
Mimosa modesta Mart.	-	Sub-shrub	RCO 2206
Mimosa paraibana Barneby	-	Tree	RCO 2207
Mimosa sensitiva L.	-	Liana	RCO 2187
Mimosa tenuiflora (Willd.) Poir.	jurema-preta	Tree	RCO2303[b]
Parkinsonia aculeata L.	-	Tree	ASS 22
Piptadenia stipulacea (Benth.) Ducke	jurema-branca	Tree	RCO 1948
Piptadenia viridiflora (Kunth) Benth	-	Tree	ASS 1
Pithecellobium diversifolium Benth.	Espinheiro	Tree	RCO 2349
Pithecellobium dulce (Roxb.) Benth.	Carolina	Tree	ASS 5
Poincianella bracteosa (Tul.) L.P.Queiroz	Catingueira	Tree	RCO 1964
Poincianella pyramidalis (Tul.) L.P. Queiroz	Catingueira	Tree	RCO 2139
Prosopis juliflora (Sw.) DC.	-	Tree	No voucher
Rhynchosia minima (L.) DC.	-	Liana	RCO 1814
Sesbania exasperata Kunth	-	Sub-shrub	ASS 30
Senna martiana (Benth.) H.S. Irwin and Barneby	flor-de-são-joão	Tree / Shrub	RCO 2138
Senna spectabilis (DC.) H.S. Irwin and Barneby	Canafístula	Tree / Shrub	RCO 1947
Senna rizzinii H.S. Irwin and Barneby	-	Tree	RCO 1823
Stylosanthes sp.	-	Herb	RCO 2121
Tephrosia purpurea (L.) Pers.	-	Sub-shrub	RCO 2327
Vachellia farnesiana (L.) Wight and Arn.	Coronha	Shrub	RCO 1946
sp.1	-	Herb	ASS 39
Gentianaceae			
Schultesia doniana Progel		Sub-shrub	RCO 1954
Gesneriaceae			
Sphaerorrhiza sarmentiana (Gardner ex Hook.) Roalson and Boggan	-	Herb	RCO 2209
Hydrocharithaceae			
Apalanthe granatensis (Bonpl.) Planch.	-	Herb	RCO 2113
Hydroleaceae			
Hydrolea spinosa L.	-	Sub-shrub	RCO 1950
Lamiaceae			
Marsypianthes cf. *chamaedrys* (Vahl) Kuntze	-	Herb	RCO 2142
Vitex gardneriana Schauer	Jarimataia	Tree	RCO 2332

Table 2. ***Continued.***

SPECIES	COMMON NAME	HABIT	VOUCHER
sp.	-	Sub-shrub	RCO 2252
sp.	-	Herb	RCO 2112
Lythraceae			
Cuphea campestris Koehne	-	Herb	RCO 2136
Malpighiaceae			
Heteropterys sp.	-	Liana	RCO 1966
Stigmaphyllon paralias A. Juss.	buquê-de-noiva	Shrub	RCO 2173
Malvaceae			
Guazuma ulmifolia Lam.	-	Tree	ASS 54
Herissantia crispa (L.) Briziky	-	Sub-shrub	RCO 2144
Herissantia tiubae (K. Schum.) Brizicky	-	Herb	RCO 2311
Sida ciliaris L.	-	Sub-shrub	RCO 2175
Sida sp.	-	Herb	ASS 33
sp.1	-	Sub-shrub	RCO 1958
Maranthaceae			
Thalia geniculata L.	-	Herb	RCO 2160
Meliaceae			
Trichilia hirta L.	barandão	Tree	RCO 2324
Moraceae			
Ficus guianensis Desv. ex Ham.	gameleira	Tree	RCO 2218
Myrtaceae			
Myrciaria tenella (DC.) O.Berg	goiabinha	Tree	ASS 13
Nyctaginaceae			
Boerhavia sp.	pega-pinto	Herb	ASS 37
Nymphaeaceae			
Nymphaea ampla (Salisb.) DC.	-	Herb	RCO 2302
Nymphaea gardneriana Planch.	-	Herb	RCO 2232
Onagraceae			
Ludwigia decurrens Walter	-	Herb	RCO 1965
Ludwigia grandiflora (Michx.) Greuter and Burdet	-	Herb	ASS 25
Ludwigia helminthorrhiza (Mart.) H.Hara	-	Herb	ASS 11
Ludwigia octovalvis (Jacq.) P.H.Raven	-	Herb	ASS 7
Oxalidaceae			
Oxalis glaucescens Norlind	-	Herb	RCO 2128
Phytolaccaceae			
Petiveria alliacea L.	-	Herb	RCO 2228
Plantaginaceae			
Angelonia cf. *biflora* Benth.	-	Herb	RCO 2238
Angelonia campestris Nees and Mart.	-	Herb	RCO 1959
Plumbaginaceae			
Plumbago sp.	-	Sub-shrub	RCO 2143
Poaceae			
Aristida adscensionis L.	-	Herb	RCO 2147
Aristida elliptica (Nees) Kunth	-	Herb	RCO 1935
Axonopus capillaris (Lam.) Chase	-	Herb	RCO 2194
Bouteloua americana (L.) Scribn.	-	Herb	RCO 2105
Cenchrus cf. *pedicellatus* (Trin.) Morrone	-	Herb	RCO 2163
Cenchrus purpureus (Schumach.) Morrone	-	Herb	RCO 2166
Chloris barbata Sw.	-	Herb	RCO 2161
Dactyloctenium aegyptium (L.) Willd.	-	Herb	RCO 2108
Digitaria bicornis (Lam.) Roem. and Schult.	-	Herb	RCO 2109
Echinochloa colona (L.) Link	-	Herb	RCO 2333
Echinochloa polystachya (Kunth) Hitchc.	-	Herb	RCO 2155
Eleusine indica (L.) Gaertn.	-	Herb	RCO 2162
Enteropogon mollis (Nees) Clayton	-	Herb	RCO 2148
Eragrostis ciliaris (L.) R.Br.	-	Herb	RCO 2197
Eragrostis glomerata (Walter) L.H.Dewey	-	Herb	RCO 2250
Eragrostis hypnoides (Lam.) Britton	-	Herb	RCO 2313
Eragrostis pilosa (L.) P.Beauv.	-	Herb	RCO 2106
Eriochloa punctata (L.) Desv. ex. Ham.	-	Herb	RCO 2115

Table 2. ***Continued.***

SPECIES	COMMON NAME	HABIT	VOUCHER
Panicum dichotomiflorum Michx.	-	Herb	RCO 2116
Panicum trichoides Sw.	-	Herb	RCO 1930
Panicum venezuelae Hack.	-	Herb	RCO 2216
Paspalidium geminatum (Forssk.) Stapf	-	Herb	RCO 2230
Paspalum fimbriatum Kunth	-	Herb	RCO 2119
Paspalum melanospermum Desv. ex Poir.	-	Herb	RCO 2159
Paspalum tumidum Kuhlm.	-	Herb	RCO 2158
Paspalum vaginatum Sw.	-	Herb	Ribeiro14
Setaria parviflora (Poir.) Kerguélen	-	Herb	RCO 2196
*Sorghum bicolor (*L.) Moench	-	Herb	RCO 2236
Steirachne barbata (Trin.) Renvoize	-	Herb	RCO 2254
Tragus berteronianus Schult.	-	Herb	RCO 2150
Urochloa fusca (Sw.) B.F. Hansen and Wunderlin	-	Herb	RCO 2149
Urochloa mutica (Forssk.) T.Q.Nguyen	-	Herb	RCO 2156
Polygalaceae			
Polygala boliviensis A.W.Benn.	-	Herb	RCO 2203
Polygala cf. *bryoides* A.St.Hil. and Moq.	-	Herb	RCO 2133
Polygonaceae			
Coccoloba sp.	-	Tree	ASS 49
Triplaris gardneriana Wedd.	coaçu	Tree	ASS 18
sp.	cipó-verdadeiro	Liana	RCO 2335
Pontederiaceae			
Eichhornia crassipes (Mart.) Solms	aguapé	Herb	RCO 1813
Heteranthera seubertiana Solms	-	Herb	ASS 6
Rhamnaceae			
Ziziphus joazeiro Mart.	-	Tree	No voucher
Rubiaceae			
Borreria capitata (Ruiz and Pav.) DC.	-	Herb	RCO 1934
Borreria scabiosoides Cham. and Schltdl.	-	Herb	RCO 2154
Diodella apiculata (Willd. ex Roem. and Schult.) Delprete	alecrim-do-pasto	Herb	RCO 2185
Machaonia brasiliensis (Hoffmanns. ex Humb.) Cham. and Schltdl.	-	Tree	ASS 44
Spermacoce tenuior L.	-	Herb	RCO 2131
Tocoyena formosa (Cham. and Schltdl.) K.Schum.	jenipapo	Tree	RCO 2170
Tocoyena sellowiana (Cham. and Schltdl.) K.Schum.	jenipapo	Tree	ASS 40
Santalaceae			
Phoradendron bathyoryctum Eichler	erva-de-passarinho	Hemi-parasite	ASS 52
Sapindaceae			
Cardiospermum halicacabum L.	-	Liana	RCO 2225
Cardiospermum sp.	saia-de-acauã	Liana	RCO 1969
Paullinia sp.	-	Liana	RCO 2134
Paullinia pinnata L.	-	Liana	RCO 1937
Sapindus saponaria L.	sabonete	Tree	ASS 41
Serjania comata Radlk.	saia-de-coã	Liana	RCO 2304
sp.1	-	Tree	ASS 20
Sapotaceae			
Sideroxylon obtusifolium (Humb. ex Roem. and Schult.) T.D.Penn	quixabeira	Tree	Não coletada.
Scrophulariaceae			
sp.1	-	Herb	RCO 2210
sp.2	-	Herb	RCO 1956
Solanaceae			
Lycium martii Sendtn.	-	Tree	RCO 2350
Solanum paniculatum L.	jurubeba	Herb	ASS 21
sp.1	-	Sub-shrub	RCO 1816
sp.2	-	Herb	RCO 2125
Urticaceae			
Laportea aestuans (L.) Chew	-	Herb	RCO 1932
Verbenaceae			
Avicennia germinans (L.) L.	mangue	Tree	RCO 2353
Avicennia schaueriana Stapf and Leechm. ex Moldenke	-	Tree	Ribeiro 87
Lantana camara L.	camará	Sub-shrub	ASS 29

Table 2. ***Continued.***

SPECIES	COMMON NAME	HABIT	VOUCHER
Lantana fucata Lindl.	erva-cidreira	Sub-shrub	RCO 1927
Lippia alba (Mill.) N.E.Br.	-	Sub-shrub	RCO 1955
Lippia gracilis Schauer	-	Sub-shrub	RCO 1928
Lippia sp.	-	Herb	RCO 2117
Stachytarpheta coccinea Schauer	-	Shrub	RCO 2215
Vitaceae			
Cissus verticillata (L.) Nicolson and C.E.Jarvis	-	Liana	ASS 47

Table 3. Total number of tree taxa, exclusive and common to the riparian vegetation of the rivers and the Sørensen index: PB = Taperoá, Paraíba (Lacerda *et al.* 2005); PE = Pajeú, Pernambuco (Souza and Rodal 2010) and RN = Apodi-Mossoró, Rio Grande do Norte (present study).

	EXCLUSIVE TAXA/ TOTAL			TAXA COMMON TO AREAS			
	PB	PE	RN	PB/PE	RN/PB	RN/PE	RN/PB/PE
	18	08	46	11	23	17	09
Total/Sørensen	43	25	77	0,32	0,38	0,33	0,12

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LISTS OF SPECIES

List of Angiosperm species of the riparian vegetation of the Apodi-Mossoró river, Rio Grande do Norte, Brazil

Regina Célia de Oliveira [1*], Anádria Stéphanie da Silva [1], André Rodolfo de Oliveira Ribeiro [1], José Erivaldo de Araújo [2], Odaci Fernandes de Oliveira [2] and Ramiro Gustavo Valera Camacho [3]

1 University of Brasília, Institute of Biology, Department of Botany, PO Box 4457, 70919-970. Brasília, Distrito Federal, Brazil.
2 Federal Rural University of Semiarid, Department of Plant Sciences, PO Box 137, 59625-900. Mossoró, Rio Grande do Norte, Brazil.
3 Rio Grande do Norte State University, Department of Biological Sciences, PO Box 70, 59610-210. Mossoró, Rio Grande do Norte, Brazil.
* Corresponding author. Email: *reginacelia@unb.br*

ERRATUM

On page 740: Apodi – Mossoró **should be read as** Apodi-Mossoró.

On pages 740, 741 and 743: Apodi Mossoró **should be read as** Apodi-Mossoró.

On page 740: mineral exploration **should be read as** mineral exploitation.

On pages 740 and 741: Governor Dix-Sept Rosado **should be read as** Governador Dix-Sept Rosado.

On page 740: Andrade Lima **should be read as** Andrade-Lima.

On pages 740 and 743: Paraiba **should be read as** Paraíba.

On page 741: Planaltos Residuais **should be read as** residual elevated plains.

On page 742: The correct caption **should be:**

FIGURE 2. Some herbaceous species of Apodi-Mossoró River, Rio Grande do Norte, Brazil. HYDROLEACEAE: A. *Hydrolea spinosa* L.; MARANTACEAE: B. *Thalia geniculata* L.; ALSTROEMERIACEAE: C. *Bomarea edulis* (Tussac) Herb.; ACANTHACEAE: D. *Ruellia asperula* (Mart. and Nees) Lindau; CUCURBITACEAE: E. *Rytidostylis amazonica* (Mart. ex Cogn.) Kuntze; F. *Luffa operculata* (L.) Cogn.; POACEAE: G. *Echinochloa polystachya* (Kunth) Hitchc.; CYPERACEAE: H. *Pycreus polystachyos* (Rottb.) P. Beauv.

On page 742: The correct caption **should be:**

FIGURE 3. Some tree and shrub species of Apodi-Mossoró River, Rio Grande do Norte, Brazil. FABACEAE: A. *Erythrina velutina* Willd. SAPINDACEAE: B. *Sapindus saponaria* L. Fruits; APOCYNACEAE: C. *Cryptostegia grandiflora* R. Br., Invasive species; FABACEAE: D. *Geoffroea spinosa* Jacq.; POLYGONACEAE: E. *Triplaris gardneriana* Wedd. Fruits; CHRYSOBALANACE: F. *Licania rigida* L. Benth. Roots; FABACEAE: G. *Albizia inundata* (Mart.) Barneby and J.W. Grimes; ARECACEAE: H. *Syagrus cearensis* Noblick.

On page 743: Ranga and Rao 2005 **should be read as** Rezende and Ranga 2005.

On page 743: Andrade-Lima (1982) and Andrade Lima (1982) **should be read as** Andrade-Lima (1981).

On pages 743 and 744: Luiz Gomes **should be read as** Luís Gomes.

On page 744: "algarroba" **should be read as** "algaroba".

On page 750, the following reference is lacking:

Barros, T.C.L., O.C. Lira, and A.J.R. Silva. 1988. Distribuição geográfica das Pteridófitas ocorrentes no Estado de Pernambuco, Brasil. *Acta Botanica Brasilica 2(1-2): 47-86.*

We regret these errors.

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